DOCUMENT RESUME

ED 182 544 CE 024 138

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TITLE Instructional Concepts for Occupational Education. Special Interest Paper. An Occasional Publication for Selected Audiences, No. 20.
INSTITUTION City Univ. of New York, N.Y. Center for Advanced Study in Education.; City Univ. of New York, N.Y. Inst. for Research and Development in Occupational Education.; New York State Education Dept., Albany. Office of Occupational and Continuing Education.
PUB DATE Jan 80
NOTE 13p.

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Achievement; *Behavioral Objectives; *Behavior Change; Career Education; Curiosity; Discovery Learning; *Discovery Processes; Discrimination Learning; Generalization; *Learning Motivation; Learning Processes; *Learning Theories; Prompting; *Reinforcement; *Stimuli; Student Behavior; Student Motivation; Success Factors; Teaching Techniques

ABSTRACT

Teachers and teacher educators seem to be little aware of some major concepts about instruction that provide important insights into the central requirements for learning. A common misconception is that motivation has to do with wanting or desiring. It is instead attention to stimuli that is influenced by two powerful agents--(1) suspense, discovery, curiosity and (2) reinforcement. Introduction of new learning by the arousal and subsequent relief of curiosity is one important motivational tactic. Reinforcement for correct responses or prompt knowledge of results leads to increased student success at the task, which is the most powerful motivator for learning. Student errors can either be corrected immediately to maximize student success or planned by the instructor to result in learner annoyance or perplexity to lead him into the desired responses. Guidance or prompting should be limited to early stages of learning; confirmation of unprompted responses should characterize the vast bulk of instruction. Student behavior should be shaped through a series of successive approximations to the eventaul terminal behavior by specifying in measureable terms the standard of acceptability at each stage of learning. Explicit generalization of discrimination training, as applicable, is recommended for presenting the confusable elements present in every learning task. (YLB)

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Special Interest Paper
An Occasional Publication for Selected Audiences

#20

January 1980

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INSTRUCTIONAL CONCEPTS FOR OCCUPATIONAL EDUCATION

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One of the major thrusts of the U.S. Office of Education during the 1970's related to career development in general and to education and training for the less-than-baccalaureate world of work in particular. That thrust provides to occupational education exceptional opportunities to lead the way for the rest of education toward the improvement of instruction, toward sounder teaching procedures than have been characteristic.

Specialists in instructional processes have long pointed to something of an iron curtain between reliable evidence about learning and teaching processes and actual classroom practices. The findings of the experimental psychology of learning have barely begun to be represented in some of the most recent textbooks in educational psychology and are nearly nonexistent in the journal literature aimed at practicing teachers. One consequence is that practicing teachers are virtually closed off from information that could bring about substantial revision of their understandings about learning processes and, in turn, considerable improvement in their instructional procedures and, therefrom, in the achievement of students.

The present article describes for occupational teachers and occupational teacher educators some of the major concepts about instruction that seem to be little known by teachers and teacher educators: ones that provide important insights into the central requirements for learning

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and that can serve as correctives to some of the folklore that, however prominent in the understandings of many teachers, has no basis in fact. Moreover, the concepts are not at a remote theoretical level, but are immediately and easily translatable into specific instructional acts. Described, in turn, are the concepts and associated instructional behaviors that pertain to motivation (suspense, discovery, curiosity and reinforcement), error correction, guidance or prompting versus confirmation techniques, successive approximations to the desired behavior, specification of lesson objectives and assessment of their achievement, and generalization and discrimination.

First, the concept of motivation. Some persons suffer from the delusion that a person can learn anything provided he is motivated; and some rationalize poor teaching by saying that the student did not learn because he was not motivated. To many teachers, motivation has to do with a state of wanting or desiring or eagerness to learn. Motivation appears as an early heading in a lesson plan and tends to consist of some sort of pep talk designed to arouse interest. When that step is completed, the teacher goes on to other things. However, the foregoing characterizations are wide of the mark, not in agreement with the real meaning of motivation, as revealed experimentally. Motivation has little to do with wanting or desiring. Few of us are driven by a thirst for knowledge. As Bugelski (1956, p. 460) has pointed out: "What is important is that the learner be set to react to stimuli and if this is done without his wish it makes little if any difference." Motivation, in short, is attention to stimuli. Close attention is wanted throughout a lesson and is not likely to result from an early pep talk alone. Two other agents are more powerful. These are: 1) suspense, discovery, curiosity and 2) reinforcement.

Suspense, Discovery, Curiosity

Berlyne (1965) has pointed to discovery methods involving surprise, doubt, perplexity, and bafflement as important intrinsic motivators, whose effects may lie not so much in independent solution as in the arousal and subsequent relief of curiosity. We ought in education to take more advantage of the curiosity motive. We ought to do a great deal less telling and a lot more asking. Typically, the teacher "tells" or demonstrates and then asks the student to "tell it back" or to do what the teacher has demonstrated--either right away or later. Instead, by skillful teacher questioning, the learner should be led to identify, to discover, to arrive at answers and solutions--rather than merely parroting back the ready-made answers and actions that the teacher has earlier given or demonstrated. Much teaching should consist of questions on the order of: What do you suppose would happen if...? or If you wanted to do thus and such, how would you go about it? or Suppose thus and such happened, what would you do about it? and so on in this vein. Questions like these should often introduce new learning, with answers given by students, rather than by the teacher in advance. And the kinds of questions asked can range from very easy ones to ones that elicit a good deal of stumbling. The objective in arousing curiosity is to establish high interest in correct solutions, high attention when the right answer or solution appears, whether brought to light by some student or, eventually, by the teacher. In short, the teacher should get out of the bind of first telling and then asking back.

Introduction of new learning by the arousal and subsequent relief of curiosity is one important motivational tactic. More pervasive, because it applies throughout instruction, is reinforcement for correct responses or, more generally, prompt knowledge of results.

Reinforcement

The most powerful motivator for learning is success at the task. The instructor who teaches in such a way that students make large numbers of right answers has no motivational problems. And success at the task depends not on preachments, pep talks or threats but overwhelmingly on feedback, on informing the learner (or providing him with a way to inform himself) about the correctness of his responses and actions. First of all, as Marx (1960, p. 896) has stated in his summary of the research on reinforcement as a motivational variable, knowledge about the correctness of one's responses "is often necessary to gauge and adjust performance; this is more apparent in regard to the improvement of motor skills." Secondly, the promptness or immediacy of knowledge of results is crucial, in view of "the experimental literature which rather uniformly suggests time intervals on the order of seconds. The reinforcing value of a high grade given at the end of a semester can have little or no direct effect on the learning of skills or content during the semester" (Bugelski, 1956, p. 463). In motor or manipulative skills, "in which motions take place in fractions of a second and cannot be reconstituted later on, knowledge of results that is delayed more than fractions of a second loses its value" (West, 1969, p. 448).

In conventional instruction, I think we tend to be weak in two ways: We do not regularly or frequently enough provide the learner with knowledge of results and, in motor or manipulative skills in which immediacy is crucial, we do not provide that information within seconds of the learner's response. The motivational requirement of many successes by the learner means two things: that the sequencing and pacing and clarity of the instruction be such as to maximize the number of right answers and, also, that mistakes be swiftly identified and corrected. Both require frequent

and prompt knowledge of results. It serves as a corrective for wrong responses and as reinforcement for correct responses. Let us then examine our instruction with a view to identifying ways to let the learner know about the correctness of his behavior--not merely at the end of each lesson or via periodic, formal tests, but moment by moment throughout instruction.

Error Correction

In connection with student errors, by the way, it was William James who said that to form a habit, never suffer an exception to occur. To which one might respond: "Nice work if you can do it" and also "Sometimes you want errors to occur." The student pilot, for example, intentionally sideslips the aircraft or stalls the motor in order to learn the actions necessary to pull the plane out of a sideslip or stall. The child learning to ride a bicycle must be allowed to fall off or nearly fall off a number of times in order to identify those sensations in his muscles that signify imminent falling off and to practice the corrective muscular movements. The student driver should skid a number of times in order to learn what to do in a skid. Your carpentry students have to use a plane and a saw at the wrong angle, not only to see at first hand the consequences of such misbehavior, but also to sensitize them to the muscular sensations that go with right and wrong ways to handle a plane or saw. No doubt, gouged wood and ripped lumber occur aplenty at the start, without the teacher's deliberate intent. The point of these illustrations is merely to suggest that the consequences become vivid to the learner so that corrective actions can be learned. Not all conceivable errors should be made to happen, but only those that have important consequences. Tying the principle of delib-

erate errors to the curiosity motive mentioned earlier, whenever health and safety are not at stake or the destruction of materials too costly, perhaps one should often assign a new task without any prior instruction, in expectation that the desired errors will occur or that the problem at issue will not be solved. The learner's resulting annoyance or perplexity can serve as excellent springboards for leading him into the desired responses.

Guidance or Prompting versus Confirmation Techniques

The previous illustration is a special instance of a more general phenomenon that has pervasive implications for the conduct of instruction, implications that tend, I think, to be outrageously violated in much conventional instruction, especially of low-ability students. The general phenomenon bears the label "guidance or prompting versus confirmation techniques." Guidance or prompting refers to telling or showing the learner in advance of his response what response you want him to make. That's what teachers generally do. They do not permit the learner to draw a breath or make a move until they have shown him how to breathe and move. The opposed tactic, called "confirmation," consists of requiring a response by the learner without prior guidance and of informing him, only after he has responded, as to the correctness of his response. A large volume of experimental evidence on the relative merits of prompting vs. confirmation tactics points uniformly in one direction, expressed in the following generalization: Prompting or guidance is more powerful than confirmation when used in very small amounts entirely confined to the earliest stages of learning any new thing. Too long continued into later stages of learning or practice, or given in large amounts, it is harmful

(Bugelski, 1956; Stolurow, 1959). Confirmation is vastly the superior tactic once past the earliest learning stages.

In the face of that established generalization about the conduct of instruction, I suspect that many teachers, in their eagerness to have learners perform without mistakes, lead him by the hand interminably, giving him even at late stages of learning or practice detailed instructions and a variety of hints or guides. The consequence often is inability to perform the task when the umbilical cord is cut. Cut the umbilical cord early. Let the learner early stand on his own feet--but be swift with confirmation, quick to give him an assessment of his efforts. Responses that are not followed by swift knowledge of results are learned slowly at best, and sometimes not at all.

Successive Approximations to the Desired Behavior

In connection with assessment of student responses, one important thing to guard against is too early use, as a criterion of acceptability, of the behavior expected of the fully trained person. Skinner has aptly referred to the shaping of behavior, to accepting from the learner as the training proceeds successively closer approximations to the skilled responses and finished products that represent the terminal objectives of a given unit of instruction. However, vagueness in identifying the step-by-step approaches to a fully adequate product will not do. Instead, the need is to specify quantitatively, in measurable amounts, the size of the improvement in responses that is expected as the learning proceeds. One might expect a skilled auto mechanic to replace a fan belt on a certain model of car in, say, 30 minutes; but during training it is wise to specify a series of worktime goals eventually reaching 30 minutes, such as: 50 minutes at the first trial, 40 minutes by the third trial, and so on.

The skilled carpenter should be able to square an edge so that no light shows through when a tri-square is laid over it. But the trainee might be allowed a 3-mm. gap at the outset, later on a 2-mm. gap, and so on. At every stage of learning the learner should have some way of assessing his performance, measurably, in relation to what is expected of him at that stage. Precise feedback, not general judgments, are required.

The precision of these sample standards of acceptability lead me to another concept having to do with specification of lesson objectives and assessment of their achievement.

Specification of Lesson Objectives and Assessment of Their Achievement

A lesson plan is an agenda for the teacher, so it is easy to understand why lesson objectives have traditionally been stated in terms of what the teacher wants to accomplish. But that's wrong. Whether for a single lesson, a weekly unit of instruction, or an entire course of instruction, it is infinitely preferable to state objectives in terms of learner behavior. A well stated instructional objective specifies, in behavioral terms, what the learner is to be capable of doing upon completing some specified unit of instruction. In a very early typewriting lesson a teacher objective might be "To teach the keyboard letters i, f, t, s." Properly written in terms of learner behavior the objective might be: "To type for 2 minutes words and phrases using the letters i, f, t, and s at a rate of not less than 10 words per minutes with no more than 4 errors." Or, compare: "To teach fan belt replacement" with "To replace a fan belt in car X in 30 minutes." The latter statement mandates a measure of fan belt replacement speed among students, thereby providing a check on the achievement of the objective. The alternative--the objective stated in terms of teacher behavior--too often leads to instruction

in which the achievement of objectives is uncertain, because undetermined. The test of a good lesson is not what the principal or department chairman or other qualified observer thinks of a teacher's procedures, but what learners are able to do upon completion of the lesson. Therefore write lesson objectives that specify student behaviors in measurable terms. In contrast to the difficulties of specifying the hallmarks of "appreciation" in a course in music appreciation, occupational education lends itself very well to precise specification of objectives in terms of learner behaviors, and our instruction would be greatly sharpened were we to do so routinely. Robert Mager's classic little paperback (1962) may be consulted as a guide on the writing of instructional objectives.

Generalization and Discrimination

My final point has to do with characteristics found in every learning task under the sun, from learning to tie your shoelaces to mastering Chinese metaphysics. The reference is to the terms stimulus generalization, response generalization, stimulus discrimination, response differentiation--terms that I suspect are pure Greek to most teachers. Yet those terms drive right to the heart of the prominent learning difficulties. Stimulus generalization refers to the tendency to perceive two different stimuli as alike, so that one makes the same response to the different stimuli. Sometimes, that's what you want, as in making the same oral reading response to to, too, and two. At other times you want the learner to discriminate among similar stimuli so that he can make a different response to each. Many beginning readers confuse b with d and read bare for dare and vice versa. The person learning to receive Morse Code often confuses the signal for A from the signal for N. At the response end, the typist strikes r for t and vice versa because they are adjacent on the typewriter keyboard.

Every learning task, without exception, has elements that tend to be highly confusable to learners, ones that experienced teachers are well aware of. But what teachers are not aware of is that there are explicit techniques for producing generalization when that is wanted and for producing discrimination when that is wanted. One speaks of "generalization training" and of "discrimination training." To illustrate the latter, consider the Morse Code confusion of A and N. Discrimination training consists of sending many pairs of these letters in all possible combinations, viz., A-A, A-N, N-A, N-N, in random order. The learner's first task is merely to respond "same" or "different" after each pair of signals is sent. Only when he can dependably identify when the members of each pair are the same and when different--only when he can tell the sounds apart--is he then taught that dih-dah is A and dah-dit is N. Identical tactics apply to teaching the beginning reader to distinguish a small b from a small d. Reading also makes a convenient illustration of generalization training. A longhand a lower-case small printed r, and an upper-case capital R all have to elicit the same vocal sound. Three different visual stimuli are to elicit the same vocal response. The training tactic consists of confirming or reinforcing the desired vocal response when it is made to the appropriate stimuli, and the stimuli are to be presented in sets whose members sometimes call for a common response, sometimes not.

As I have said, experienced teachers are keenly aware of the prominent difficulties in the tasks or subject matters they teach. Instead of living with those difficulties indefinitely, they can be overcome swiftly and permanently by employing the techniques of generalization and discrimination training. Which twin wears the Toni? Is this olive oil or peanut oil? Does a clogged whatchamacallit make the automobile motor sound this

way? or this way? Here are two fabric swatches; are they the same (both orlon? both nylon? or what?)? Often, one must start with pairs of items which are greatly different, progressively thereafter narrowing the difference until fine discriminations are required and established. The same applies to generalization training. The typist or secretary or teacher must learn to decipher (i.e., make the same responses to) all sorts of longhand from an elegant Spencerian script to a nearly impenetrable scribble.

Summary

I have suggested in this paper that we stop rationalizing away our failures and that we move from the ineffective folklore on which much instruction has traditionally been based to a sound psychology of learning. The particular concepts discussed here lead to eight recommendations, as follows:

1. Instructional objectives should specify measurable learner behaviors, not teacher activities.
2. Take advantage of curiosity as an intrinsic motivator.
3. Teachers should do more asking and less telling.
4. Learners' responses should be followed by swift and precise knowledge of results.
5. The important errors--the ones that have serious consequences--should be made to occur, so that corrective actions can be learned.
6. Shape behavior through a series of successive approximations to the eventual terminal behavior by specifying in measurable terms the standard of acceptability at each stage of learning.
7. Teacher guidance of the learner should be given in small amounts entirely confined to early learning stages; confirmation of unprompted responses should characterize the vast bulk of instruction.

8. Attack the confusable elements in a learning task by conducting explicit generalization or discrimination training, as applicable.

There are other major concepts besides those listed above, and under each there is a myriad of details. Nothing mentioned here is exclusive to occupational education, but is applicable to all instruction of all persons. However, in contrast to what one might mean by aporeciating music or being an effective citizen, occupational tasks lend themselves much more readily to precise specification of objectives and to precise measurement of learner performances. Thus, the opportunities in occupational education are so challenging that, with the infusion of a genuine psychology of learning, occupational education could lead the way for the rest of education.

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